April 29, 1952 R. G. MAWNEY 2,594,670

CONTROL RELAY

Filed July 16, 1949 2 SHEETS—SHEET 1

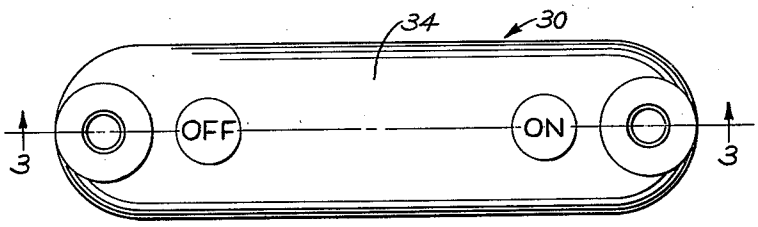


Fig. 1.

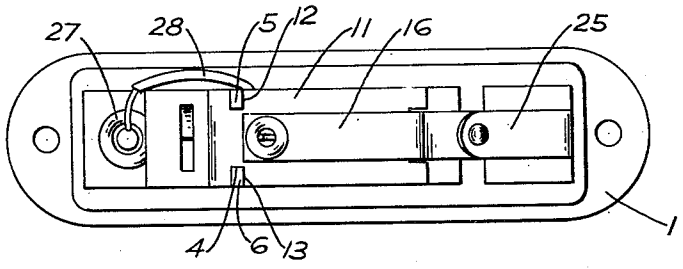


Fig. 2.

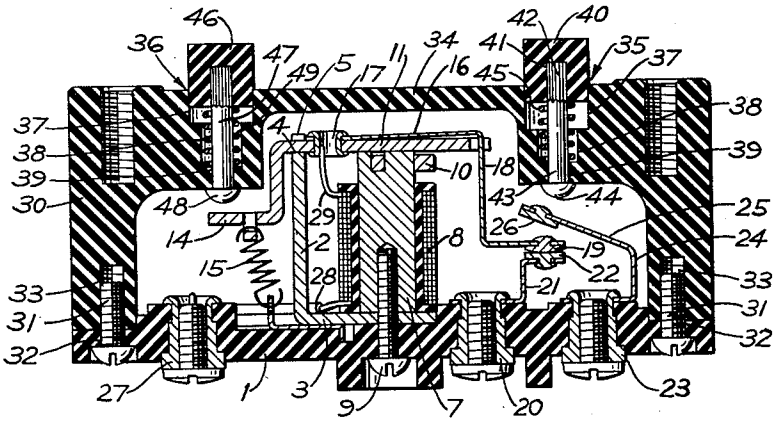


Fig. 3.

INVENTOR.

ROBERT G. MAWNEY

BY

Townsend M Gunn

ATTORNEY

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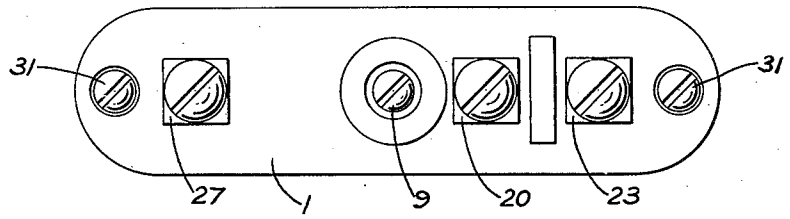


Fig. 4.

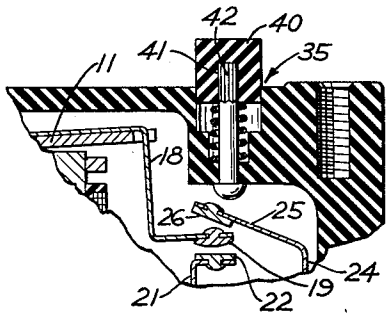


Fig. 5.

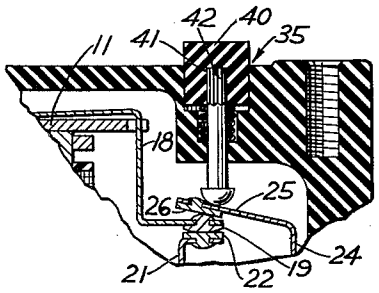


Fig. 6.

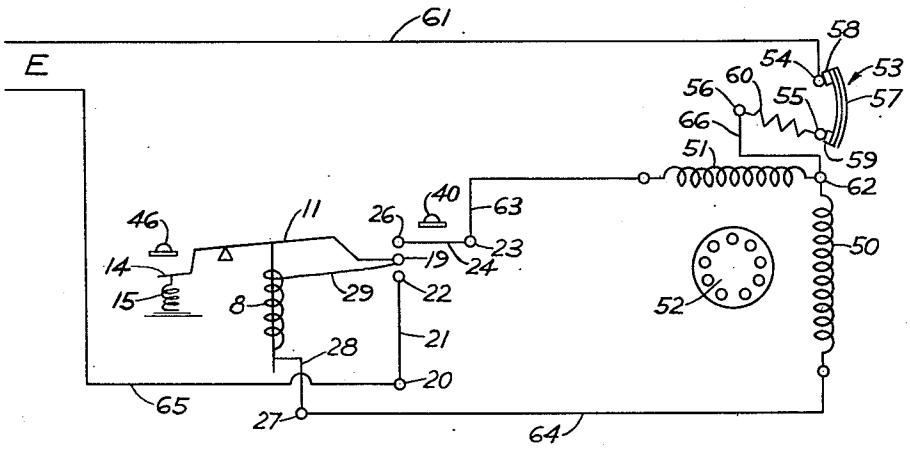


Fig. 7.

INVENTOR.
ROBERT G. MAWNEY
BY
Townsend & Townsend
ATTORNEY

Patented Apr. 29, 1952 2,594,670

UNITED STATES PATENT OFFICE

2,594,670

CONTROL RELAY

Robert G. Mawney, Attleboro, Mass., assignor to Metals & Controls Corporation, Attleboro, Mass., a corporation of Massachusetts

Application July 16, 1949, Serial No. 105,176

4 Claims. (Cl. 200—87)

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This invention relates to electromagnetic relays, and in particular to a combination control relay and starting switch for electric motors.

Among the several objects of the invention may be noted the provision of a simple, improved form of electromagnetic relay; the provision of a simple manually-reset electromagnetic relay of the electrical "lock-in" type; the provision of an electromagnetic relay of the class described in which are included means for controlling two circuits independently of each other; the provision of a simple form of a relay of the class described in which is incorporated a starting switch for a motor, the starting switch being separately actuable and coacting with the relay-actuated switch in a predetermined sequence; the provision of a simple form of a relay of the class described for establishing first and second external circuits substantially simultaneously and including means for thereafter interrupting one of said circuits independently of the other; the provision of a novel relay and starting switch combination for starting and stopping an electric motor having starting and running windings; and the provision of a device of the last-named class in which is provided a simple and novel means for maintaining control of the starting winding of the motor until the motor is running. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

Referring now to the drawings, in which is illustrated one of various possible embodiments of the invention:

Figure 1 is a top plan view of one embodiment of the relay of the present invention;

Figure 2 is a top plan view of the relay of Figure 1, with the cover thereof removed;

Figure 3 is a cross section taken substantially along lines 3—3 of Figure 1 and showing the relay contacts in the position they occupy after the motor has been started and is running;

Figure 4 is a bottom plan view of the relay of Figure 3;

Figure 5 is a portion of the relay of Figure 3, to show the relay contacts in an initial circuit-open position;

Figure 6 is a view similar to Figure 5, but showing the relay contacts in an intermediate, motor-starting position; and

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Figure 7 is a schematic diagram of a circuit in which the relay of this invention may be used.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

In the use of motors which are protected from over-heating by a thermostat mounted on the motor, it is often desirable to use a circuit such that if the protecting device on the motor once opens the circuit, it is necessary for the operator of the motor to perform some voluntary act to start the motor again. This is customarily done by having a manually reset circuit, which requires actuation by the operator of the motor in order to start the motor. In addition to this, where the so-called split phase motors are used, it is sometimes desirable to energize the starting winding of the motor by means of a switch located outside of the motor instead of the usual type of expensive centrifugal switch or starting relay.

It is the purpose of this invention, therefore, to provide an electromagnetic relay to accomplish the above purposes, which embodies a simple starting switch which must be manually closed in order to start the motor, and which is of the type which stays locked-in electrically once the relay contacts are closed to keep the motor running. In order to understand more fully the construction of this relay, reference will now be had to the drawings and description.

Referring to Figure 3, a base 1 of electrically insulating material (such as one of the molded phenolic resins) is provided. An L-shaped bracket having a vertical leg 2 and a horizontal leg 3 is mounted on base 1 as shown, and the upper end of leg 2 is bifurcated as indicated at 4 to provide upstanding ears 5 and 6. Seated on the horizontal leg 3 is an iron pole-piece 7 on which is wound the turns of coil 8. Screw 9 passes through a hole in base 1 and is threaded into pole-piece 7 to clamp leg 3 and the pole-piece 7 to the base. A shading coil 10, comprising a single loop of copper, is inserted into the top of pole-piece 7 as shown, in accordance with usual practice in relays designed to operate on alternating currents.

An armature 11 of suitable iron or steel is provided having slots 12 and 13 cut in its sides and adapted to receive freely the upstanding ears 5 and 6, respectively, of bifurcation 4. In this way armature 11 is both pivoted and held on the end of leg 2. If desired, ears 5 and 6 may be slightly headed over to retain armature 11 more securely in bifurcation 4. Attached to a bent-

down end 14 of said armature is one end of a spring 15 the other end of which is attached to base 1, spring 15 being so tensioned as to bias armature 11 counter-clockwise and away from the top of pole-piece 7.

One end of a flat spring arm 16 is attached by means of a rivet or eyelet 17 to armature 11 as shown. The other end of the spring arm 16 is bent downwardly over the end of armature 11 and to the right, as indicated at 18, and bears at this latter end the contact 19.

Mounted on base 1 by means of the headed-over inner end of terminal rivet 20 is the upright contact arm 21 which carries on its bent-over upper end the stationary contact 22. Also mounted on base 1 in like manner by the headed-over inner end of terminal rivet 23, is the upright spring contact arm 24 which carries on its free end 25 the movable contact 26. Spring arm 24 and spring arm 18 are so formed and positioned in respect to spring arm 21, that when the coil 8 of the relay is deenergized the contacts 26 and 19 occupy approximately the fully open positions shown in Figure 5, being biased away from contact 22 by the action of spring arm 24 and spring 15, respectively.

It will be noticed that spring arm 24 is so formed that its upper bent-over arm portion 25 is at an angle to the horizontal, even when the various contacts of the relay are in fully closed position. The purpose of this will be explained below, when the operation of the relay is described.

A third terminal 27 similar to terminals 20 and 23 is provided on base 1 and to this is electrically connected one end of coil 8, as by wire 28. The other end of coil 8 is electrically connected by flexible wire 29 to rivet 17 and thus to spring arm 16—18 and contact 19.

A cover 30 is provided for the relay and is fastened to base 1 by means of screws 31 passing through holes 32 in base 1, the screws being threaded into properly provided threaded holes 33 in cover 30.

The top 34 of cover 30 is provided with two compound holes indicated generally at 35 and 36, which extend therethrough. Each of holes 35 and 36 comprises three coaxial cylindrical bores of unequal diameter, as follows: An outer bore 37, an inner bore 38 of less diameter than bore 37, and an innermost bore 39 of less diameter than bore 38. Compound hole 35 is fitted with a push button 40 as follows: The outer bore 37 slidably receives the push button 40 which is made of electrically insulating material, such as a molded phenolic resin. Press fitted into a hole 41 in push button 40 is the knurled end 42 of stem 43. Stem 43 is made of brass or some other suitable metal and is slidably received in and guided by innermost bore 39. A head 44 is provided on the inner end of stem 43. A compression spring 45 is mounted in the recess provided by bore 38 and engages the inner end of push button 40 to bias it upwardly, the head 40 serving to retain the whole assembly in the hole 35. In like manner, hole 36 is provided with a push button 46, stem 47 with head 48, and spring 49.

Hole 35 is so located that the head 44 of stem 43, when pushed inwardly, will bear against the free end 25 of spring arm 24 and force contacts 26, 19 and 22 together. Hole 36 is so located that head 48 of stem 47, when pushed inwardly, will bear against the end 14 of armature 11, and will pivot armature 11 counter-clockwise about the fulcrum provided by bifurcation 4 to separate armature 11 from pole-piece 7 and open contacts 19 and 22.

Referring now to Figure 7, there is shown schematically a circuit in which the relay may be used. Numeral 50 indicates the running winding of a split phase motor, and numeral 51 indicates the starting winding thereof, the rotor of the motor being indicated at 52. Mounted on the motor is a protecting thermostat indicated generally at 53. This thermostat may be of the type shown in the John D. Bolesky United States Patent 2,199,387. It comprises an electrically insulating base on which are mounted stationary terminal type contacts 54 and 55, terminal 56 and a thermostatic snap-acting disc 57. Disc 57 carries movable contacts 58 and 59 which cooperate with stationary contacts 54 and 55 respectively. If desired (and as shown here), a heater 60, positioned to heat disc 57, may be mounted between contact 55 and terminal 56. Further mechanical details as to the construction of this thermostat may be had by referring to said United States patent and need not be detailed here. Upon heating, the disc 57 snaps into an oppositely bowed shape, thus breaking the electrical connection between contacts 55 and 59, and between contacts 54 and 58. Upon cooling a predetermined amount, disc 57 snaps back to its original shape and closes said contacts. Thermostat 53 is thus of the automatically resetting type.

Contact 54 is connected by means of wire 61 to a source of electrical energy E. The common connection 62 between the running winding 50 and the starting winding 51 is connected by wire 66 to terminal 56. The other end of starting winding 51 is connected by means of wire 63 to terminal 23 of the relay. The other end of running winding 50 is connected by means of wire 64 to terminal 27 of the relay. Terminal 20 of the relay is connected by means of wire 65 to source E.

The operation of the relay is as follows: With the contacts shown in the completely open position of Figure 5, and with the thermostat 53 in the closed position as shown in Figure 7, the motor is not operating. Upon actuation of push button 40, head 44 of stem 43 presses contact 26 first into engagement with contact 19, and further pushing inwardly of push button 40 will then bring the joined contacts 26 and 19 into electrical engagement with contact 22, to make connection with source E through arm 21, terminal 20 and wire 65. Current to the motor now flows as follows: From E through wire 65, terminal 20, spring arm 21 and to contact 22, and at this point, the current splits and follows two paths: one path being to the running winding 50 of the motor and the other path being to the starting winding 51. The path to running winding 50 is through contact 19, spring arm 18—16, rivet 17, flexible wire 29, coil 8, wire 28, and wire 64. The current to the starting winding from contact 22 is through contact 19, contact 25, spring arm 24, terminal 23, and wire 63. The currents of the two windings combine at terminal 62 and pass through wire 66 to terminal 56, heater 60, contact 55, contact 59, disc 57, contact 58, contact 54, and through wire 61 to source E.

At this point, an important feature of the invention will be observed. In order to maintain firm electrical connection between contacts 19 and 22 (since push button 40 is limited in its travel by seating on the bottom of hole 37), and also to allow armature 11 to be firmly seated on pole-piece 7 when the relay is energized, arms 18

and 21 are made flexible in accordance with usual switch construction. When contacts 19 and 22 become engaged, coil 8 is energized by the relatively heavy starting current in running winding 50, and armature 11 is forcibly and suddenly attracted to pole-piece 7. This is highly desirable since contacts 19 and 22 are thus given no opportunity to chatter but instead are firmly and quickly forced into engagement. However, due to this sudden "pull-in" of these contacts, contact 19 may undergo a quick downward motion (permitted by the resilience of arm 21) which may cause it to leave contact 26, thus interrupting the current to the starting winding before the motor is fully started. To overcome this, the end 25 of arm 24 is purposely angled as shown, and this angulation has this effect: When coil 8 is energized as described above to cause the sudden increased engagement of contact 19 with contact 22, contact 19 also undergoes a wiping or sliding motion to the right (as drawn) along the face of contact 22. Due to the angulation of end 25, the face of contact 26 is at an angle to the face of contact 22 to form a resilient wedge-shaped opening. The motion of contact 19 to the right causes contact 19 to jam into this opening, thus maintaining engagement between contacts 19 and 26, in spite of the above mentioned sudden downward motion of contact 19.

With both windings of the motor thus energized, the motor will start to run. After it has reached the proper speed, push button 40 is released, allowing end 25 of spring arm 24 to move upwardly to separate contact 26 from contact 19. This interrupts the current to the starting winding, but it will be observed that since the current to the running winding is still passing through coil 8 and therefore energizing the latter, armature 11 will remain attracted to the pole-piece 7 to maintain contacts 19 and 22 in the closed position shown in Figure 3.

If it is desired to stop the motor, pushing inwardly on push button 46 will cause head 48 of stem 47 to bear against the end 14 of armature 11 to rotate the latter counter-clockwise about the fulcrum provided by bifurcation 4 a sufficient distance to separate contacts 19 and 22. When these contacts separate, the current in coil 8 is interrupted and the coil is deenergized, the armature 11 returning to the fully open position shown in Figure 5 under the biasing action of spring 15. The motor will now be completely deenergized.

If the motor is running with the contacts 19 and 22 closed as shown in the Figure 3 position, and the motor for some reason or other begins to overheat, disc 57 of thermostat 53 will function to open contacts 54—58 and 55—59 to interrupt the current to the running winding 50 of the motor. Since the current that energizes coil 8 of the relay is this same current, such interruption of the current by thermostat 53 will deenergize coil 8, allowing the contacts 19 and 22 of the relay to take the fully open position shown in Figure 5. After an interval of time sufficient for the motor to cool, disc 59 will automatically snap to close the thermostat contacts. This will not, however, restart the motor, since contacts 19 and 22 of the relay are open. To start the motor, the operator thereof must perform the voluntary act of pushing button 40 as described above.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope

of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A unitary control device for a motor having starting and running windings, comprising a base, an electromagnet mounted on the base, an armature movably mounted for cooperation with said electromagnet, a first contact mounted on said base, a second contact carried by said armature for movement thereby and adapted to engage said first contact, a third contact mounted on said base and movable toward and away from said first contact, said third contact being normally biased away from said first contact, and said second contact being positioned between said first contact and said third contact, whereby, upon motion of said third contact toward said first contact, said second contact is brought into engagement with said first contact, said second contact being provided with additional motion at an angle to its contact-closing motion and toward at least a part of said third contact whereby, upon engagement with said first contact, said second contact may move additionally in a direction toward said third contact.

2. A unitary control device for a motor having starting and running windings, comprising a base, an electromagnet mounted on the base, an armature movably mounted for cooperation with said electromagnet, a first contact mounted on said base, a second contact carried by said armature for movement thereby and adapted to engage said first contact, a third contact mounted on said base and movable toward and away from said first contact, said third contact being normally biased away from said first contact, and said second contact being positioned between said first contact and said third contact, whereby, upon motion of said third contact toward said first contact, said second contact is brought into engagement with said first contact, and means for preventing said second contact from leaving its engagement with said third contact upon energization of said electromagnet during circuit closing motion of said contacts, said means comprising resilient mountings for said first and third contacts, the mounting for said third contact positioning the latter so that its face is inclined at an angle to the face of said first contact, and the mounting for said second contact permitting said second contact to move, during a part of its travel, along the face of the first contact and to wedge into the space formed by the angle between the faces of said first and third contacts.

3. A unitary control device for an electric motor having starting and running windings, comprising a base, an L-shaped member of magnetic material mounted on said base with one leg thereof vertical and one leg horizontal, a pole-piece of magnetic material mounted on said horizontal leg parallel to said vertical leg and having an electric winding thereon, said vertical leg being bifurcated at its upper end, an armature pivoting in said bifurcated end and adapted to cooperate magnetically with said pole-piece, a resilient contact arm mounted by one end on said armature to be moved thereby and carrying a first contact on its other end, a second resilient contact arm mounted on one end on said base and carrying on its other end a second contact adapted to be engaged by said first contact, a third resilient arm mounted at one end on said

base and carrying at its other end a third contact adapted to be moved toward said second contact, said first contact being positioned between said second and third contacts whereby, on motion of said third contact toward said second contact, said first contact is brought into engagement with said second contact, means biasing said first contact away from said second contact, manual means for moving said third contact toward said second contact, and manual means for moving said first contact away from said second contact.

4. A unitary control device for an electric motor having starting and running windings, including a first contact, a movable second contact cooperating with the first contact for controlling the running winding, a movable third contact cooperating with the first contact for controlling the starting winding, and electromagnetic means for controlling the second contact, the second contact being movable to engage the first contact by actuation of the third contact to its circuit closing position, said second contact being

adapted to be retained in engagement with the first contact upon electrical energization of the electromagnetic means, and the face of said third contact being positioned at an angle to the face of said first contact so as to provide a wedge-shaped opening into which said second contact may move during a portion of its contact closing motion.

ROBERT G. MAWNEY.

REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Name	Date
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